

Heavy Metal Adsorption from Synthetic Wastewater Using Agro Waste-Based Nanoparticles: A Comparative Study

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Abstract : Heavy metal removal is critical in the wastewater treatment process due to its numerous harmful effects on human and aquatic life. There are several chemical and physical techniques for removing heavy metals from wastewater, including ion exchange, reverse osmosis, adsorption, electro dialysis, and ultrafiltration. However, adsorption technology has captivated researchers for years due to its low cost, high efficiency, and compatible with the environment. In this study, the adsorption effectiveness of three modified agro-waste materials was explored for the removal of lead from synthetic wastewater: banana peels (BP), orange peels (OP), and sugarcane bagasse (SB). The magnetite (Fe_3O_4) is incorporated with BP, OP, and SB at a ratio of 1:1 to create magnetic biosorbents. Characterization of biosorbents was carried out using scanning electron microscopy (SEM) combined with energy-dispersive X-ray (EDX) to investigate surface morphology and elemental compositions, respectively. A series of batch experiments were carried out to investigate the effects of adsorbent mass, agitation time, and initial pH concentration on adsorption behaviour, as well as adsorption isotherms and kinetics. The removal efficiency of lead by the modified agro-waste materials proved to be superior to that of non-modified agro-waste materials. The proof of concept was achieved, and agro-waste materials can be paired with adsorption technology to effectively remove lead from aqueous media. The use of agricultural waste as biosorbents will aid in waste reduction and management.

Keywords : adsorption, isotherms, kinetics, agro waste, nanoparticles, batch

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